Using Artificial Neural Networks for Analysis and Discrimination of TPF Planetary Spectra

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The Terrestrial Planet Finder (TPF) program will use low-resolution spectra to characterize extra-solar terrestrial planets, with the ultimate goal of finding global signs of life in their atmospheres or on their surfaces. The first TPF mission will be an optical coronagraph, followed by an infrared interferometer. The exact wavelength range, spectral resolution, or likely sensitivity of the spectrometer for either mission has not yet been determined. To help understand the likely strengths for spectral characterization of terrestrial planets for the optical, infrared, or combined approaches, we are using Artificial Neural Networks to discern the degree to which planetary spectra can be reliably classified as a function of wavelength coverage, spectral resolution, and signal-to-noise. To do this, we have generated synthetic spectra in both the optical and mid-infrared for a range of plausible terrestrial planets, from frozen to more Earth-like worlds, and for Earth throughout its history. These spectra are produced for a range of spectral resolutions and S/N levels. Our results indicate that Artificial Neural Networks can make important distinctions between atmospheric types at the modest resolutions and signal-to-noise likely to be characteristic of TPF planetary spectra.

Acknowledgment. V. Meadows and G. Tinetti acknowledge support by the NASA Astrobiology Institute.